The operation of the brake rocker arm **300** during an engine braking operation will now be described. During engine braking, the solenoid valve **340** is operated. Hydraulic fluid is permitted to flow from passage **12** through passageway **360** to passageway **350**. The actuator piston **320** then extends to a fully extended position such that it contacts pin **133** on crosshead **130**. When the passageway **350** is filled with hydraulic fluid and the pressure is equalized within valve **340**, a hydraulic lock is formed thus holding the actuator piston **320** in an extended position. The operation of the exhaust valve is now controlled by the brake rocker arm **300** in response to actuation by the brake cam lobe **23**. The operation of the exhaust valves will occur in response to the profile of the brake cam lobe **23**.

The brake cam lobe **23** also preferably has an exhaust gas recirculation lobe that occurs after the first braking event. This exhaust gas recirculation lobe on cam profile is disposed so that exhaust gas recirculation occurs after the first braking event, as shown in FIG. **3**. Preferably, this allows the valves to remain open, which in turn allows exhaust gases to flow into the cylinder on the power stroke, charging the cylinder prior to the second braking event. The brake cam lobe **23** once again lifts the rocker arm just before exhaust top dead center, permitting a second braking event as shown in FIG. **3**.

Effective two-cycle engine braking may be achieved in accordance with the present invention. The operating sequence of events will now be described. A first compression release cycle or braking event **1** is initiated just prior to compression top dead center, as shown in FIG **3** The exhaust valve is then reset by partially closing the exhaust valve. The partial closing of the exhaust valve permits the recharging of the cylinder through an exhaust gas recirculation event **2**, as shown in FIG. **3**. The exhaust valve is then completely closed at the completion of the exhaust gas recirculation event. During this engine operating sequence, the normal operation of the exhaust valve by the exhaust rocker **100** is disabled. The operation of the at least one exhaust valve is controlled by the brake rocker arm **300**. The profile of the brake cam lobe **23** initiates the first braking event **1** and causes the at least one exhaust valve to remain partially open during the exhaust gas recirculation event **2**.

A second compression release cycle or braking event **3** is initiated just prior to exhaust top dead center, as shown in FIG. **3**. The profile of the brake cam lobe **23** initiates the opening and closing of the at least one exhaust valve during the second braking event **3**. The opening event **4** of the at least one intake valve is delayed past the exhaust top dead center, as shown in FIG. **3**. The delayed intake valve opening prevents the valve to open when high cylinder pressure is present.

Alternate Embodiments

Continuing with the embodiments in the accompanying figures, FIG. **16** is an alternative embodiment for the means for effecting exhaust valve operation. The exhaust rocker arm **1000** is rotatably mounted on the common rocker shaft **11**. A first end of the exhaust rocker arm **1000** includes an exhaust cam lobe follower **110**

A second end of the exhaust rocker arm **1000** has a lash adjuster **120** The lash adjuster **120** is connected adjacent to a crosshead **130** The crosshead **130** is preferably a bridge device that is capable of opening two valves simultaneously. The exhaust rocker arm **1000** also includes a solenoid valve **1400**. The solenoid control valve **1400** is in communication with a fluid passageway **150** that extends through the exhaust rocker arm **100** to the lash adjuster **120**. The solenoid control valve **1400** is also in communication with a fluid passageway **160** that extends between the solenoid valve **140** and supply passage **13** of the common rocker shaft **11**. The solenoid valve **1400** combines the valve **30** and the solenoid valve **140** into a single assembly.

FIG. **17** is an alternative embodiment for the means for effecting intake valve operation. The intake rocker arm **2000** is rotatably mounted on the common rocker shaft **11**. A second end of the intake rocker arm **2000** has a lash adjuster **220**. The intake rocker arm **2000** also includes a solenoid valve **2400** The solenoid valve **2400** is in communication with a fluid passageway **250** that extends through the exhaust rocker arm **2000** to the lash adjuster **220**. The solenoid valve **2400** has the same construction as the solenoid valve **1400** described above in connection with the exhaust rocker arm **1000**.

The intake rocker arm **2000** and the exhaust rocker arm **1000** operate in substantially the same manner as the intake rocker arm **200** and the exhaust rocker arm **100**. In this embodiment, the solenoid valve **30** is eliminated.

It will be apparent to those skilled in the arts that various modifications and variations can be made in the construction and configuration of the present invention, without departing from the scope or spirit of the invention. Several variations have been discussed in the preceding text. Furthermore, it is contemplated that the present invention may be used with a common rail camless type engine whereby the above described rocker arms may be electronically operated. Others will be apparent to persons of ordinary skills in the art. It is intended that the present invention cover the modifications and variations of the invention, provided they come within the scope of the appended claims and their equivalence.

We claim.

1. An apparatus for performing multi-cycle engine braking, said apparatus comprising:

exhaust valve operating means for operating at least one exhaust valve of an engine cylinder during a positive power engine operation;

intake valve operating means for operating at least one intake valve of the engine cylinder; and

braking means for operating the at least one exhaust valve of the engine cylinder during an engine braking operation, wherein said braking means accomplishes at least two braking operations for the at least one exhaust valve per engine cycle during the engine braking operation, wherein said intake valve operating means delays the operation of the at least one intake valve during the engine braking operation.

2. The apparatus according to claim **1**, wherein said means for operating the at least one exhaust valve during the positive power engine operation includes an exhaust rocker arm.

3. The apparatus according to claim **1**, wherein said exhaust valve operating means includes exhaust valve engaging means for engaging the at least one exhaust valve to effectuate operation of the at least one exhaust valve

4. The apparatus according to claim **3**, wherein said exhaust valve engaging means releasably engages a crosshead pin of the at least one exhaust valve.

5. The apparatus according to claim **3**, wherein said exhaust valve engaging means comprises a lash adjusting assembly.

6. The apparatus according to claim **5**, wherein said lash adjusting assembly is hydraulically operated.

7. The apparatus according to claim 1, wherein said exhaust valve operating means disengages the at least one exhaust valve during the engine braking operation.

8. The apparatus according to claim 1, wherein said intake valve operating means operates the at least one intake valve during the positive power engine operation.

9. The apparatus according to claim 1 wherein said intake valve operating means includes an intake rocker arm.

10. The apparatus according to claim 8, wherein said intake valve operating means includes intake valve engaging means for engaging the at least one intake valve to effectuate operation of the at least one intake valve during the positive power engine operation.

11. The apparatus according to claim 10, wherein said intake valve engaging means releasably engages a crosshead pin of the at least one intake valve.

12. The apparatus according to claim 10, wherein said intake valve engaging means comprises a lash adjusting assembly.

13. The apparatus according to claim 12, wherein said lash adjusting assembly is hydraulically operated.

14. The apparatus according to claim 12, wherein said lash adjusting assembly retracts to a braking position during the engine braking operation such that the operation of the at least one intake valve is delayed.

15. The apparatus according to claim 1, wherein said means for operating the at least one exhaust valve of the engine cylinder during the engine braking operation includes a brake rocker arm.

16. The apparatus according to claim 1, wherein said brake rocker arm engages a crosshead pin for the at least one exhaust valve during the at least two engine braking operation.

17. The apparatus according to claim 16, wherein said brake rocker arm disengages the crosshead pin during the positive power engine operation.

18. The apparatus according to claim 1, wherein said braking means includes means to accomplish an exhaust gas recirculation event.

19. A method of performing multi-cycle engine braking, said method comprising the steps of:

performing a first compression release event, wherein said first compression release event includes the steps of opening at least one exhaust valve to effectuate engine braking and closing the at least one exhaust valve after predetermined time, wherein said step of opening the at least one exhaust valve to effectuate engine braking during said first compression release event is initiated prior to compression top dead center;

performing a second compression release event, wherein said second compression release event includes opening the at least one exhaust valve to effectuate engine braking, and closing the at least one exhaust valve after predetermined time, wherein said step of opening the at least one exhaust valve to effectuate engine braking during said second compression release event is initiated prior to exhaust top dead center; and

delaying the opening of at least one intake valve for a predetermined time during engine braking.

20. The method according to claim 19, further comprising the step of:

performing an exhaust gas recirculation event at the conclusion of said first compression release event

21 The method according to claim 19, wherein said step of opening at least one intake valve occurs after exhaust top dead center.

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